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A STUDY OF THE TORSIONS WITH A REPORT OF A CASE OF TOTAL DISASSOCIATION OF THE FUSION FACULTY*

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My direct interest in the torting of the eyes dates back some months, being first attracted by discovery of the fact that patients treated for suspension with the head fixed in position who had attained binocular fusion to a satisfactory range of ductions invariably suspended when the head was tilted. Every patient with whom I could establish contact was recalled and the observation that suspension corrected with the head in fixed position but partially relieved the condition and that further treatments were necessary.

Difficulty had been experienced, and still is, in securing perfect fusion of the "E" at 35 c.m. with the F-L card. My patients frequently call attention to a slight break in the bar of the "L" where it should join with the "F" in making an "E." It occurred to me that it was possible for binocular regard to be attained in the 180th meridian and still ignore it in the 90th. Some experiments were then conducted with color, the best results being obtained by the use of red in the stem of the "L" enough in fact to continue the use in cases indicated, and though the trend of thought does not bear out the original idea of more intense regard for red than for black, as a factor, it is still worthy of consideration. I now credit this break in the perfect "E" is due to unequal torsion of cyclophoria.

To quote Dr. R. M. Peckham, there seems to be a dearth of material on the torting of the eyes, and with the limited sources of information at my command I am able to find little beyond the assumption that the vestabular innervation is an innate function which serves to bring the two eyes in vertical alignment with the perpendicular, the eyes in turn furnishing a check against the dynamic equilibration. All this gives the equilibration innervations priority

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and such interference as is noted in the ductions are credited as being of most annoying nature, and most difficult to correct.

All this is in accord with our common experience, however, my observation does not bear out the contention that the vestabular functions are innate. Neither do they bear out a priority of vestabular control in ocular functions. On the contrary, I am convinced that the vestabular control is not an innate function, and the ocular control is predominant.

When I stand erect and give my attention to distant vision, and drop my head to one side, I experience no disturbance in vestabular control. When I close my eyes and drop the head to either side, I notice a distinct jerk in the skeletal muscles. If the head is dropped to the right the skeletal innervation is to the left, and if the head is dropped to the left the correction is to the right. The same is true if the head is dropped forward in the medial plane or back in the same plane, skeletal innervation is made in correction.

In the first instance the priority of ocular innervation overcomes the vestabular innervation which otherwise acts in the second instance until checked by prioproceptive innervations in equilibrium of the skeletal muscles.

Again in the aeroplane in fair weather and with a good aeronaut we get no sensation from extreme banking which sets the plane on wing tip other than to see the ground out beside us, a vastly different sensation from that of a circle swing which places us in similar position with relation to gravitation, only explained by the control or lack of control by ocular innervation over the vestabular.

Another;—if the torsions in an individual function for years and become deranged with the resulting syndromes, dizziness, vertigo, nausea, interrupted heart beat and even more disastrous difficulty and later we can correct the torsions by proper manipulation, and the trouble disappears, can we longer hold to the tenant that the vestabular is innate?

Facing a patient toward good light and requiring that the regard to my right eye not changing when I change my eyes and noting the patient's iris, I am usually enabled to locate some peculiarity near the temporal edge which I can use as a marker and roughly estimate the torting when the head is inclined. It would seem that in healthy normal eyes the torting approximates 30° from the medial plane.

In order that binocular single vision may be obtained the eyes must halt for a sufficient interval for the image to be recorded which necessarily results in a series of movements and halts. In a very limited number of individuals the corrections are so rapid that the movement seems continuous. It becomes entirely possible that the movement is continuous, although I doubt it. More accurate means of checking this than I have found available will be necessary to settle this.

From this point taken as normal you will find that the range decreases and the motions have longer intervals and greater movements. In these you will probably find what might be called a tendency to suspend. The greater the interval, the more pronounced you will find the tendency. In these you will find that suspension takes place with each change of inclination, may be concomitant and recovery will take place before the patient can speak the letter observed and fusion holds. So far as I have observed, you will find little hyperphoria, the duction range may be poor. We now come to these who show a difference in the tortings of the two eyes. When the difference in the range, and particularly in interval are notable, you may safely say to yourself, "This patient suspends," a fact you will easily be able to demonstrate with your F-L test.

A word of caution should be noted here; at thirty-five centimeters no suspension may be noted, be careful of, and do not put too much reliance on, your distance disassociation balance.

You may find that one eye may have full range and satisfactory tortings, the other full range with long intervals, and few vertical adjustments. In these look for total suppression, particularly if the duction range is low and esophoria pronounced. You may find that one eye torts full range and the other remains practically stationary. In this instance you will probably find vertigo. The extent of the trouble and its effects on the individual will depend on the extent to which the range is affected and the interval, amounting to anything from the reeling of drunkenness to physical incapacity in vertigo.

I have often wondered why some individuals were enabled to walk erect and show little indication of their condition long after they showed the disturbance in speech and in other ways, while in others the locomotion was affected. To my mind the reeling of a drunken man differs from the lack of stability in vertigo only in that the trouble is transient in a greater degree in the first instance. Both come from the same cause as the dread of high places on the part of your hyperphore.

All yield to proper treatment, and the peculiar thing of it is this: the hyperphore suffers from a chronic condition and is the harder to relieve. I purposely avoid the term "cure."

The assumption that the visual innervation is predominant, and the vestabular control is secondary, certainly calls for some explanation in the face of accepted information, as I understand it. It is without doubt true that the vestabular innervations do tort the eyes, and we may even admit for the purpose of argument that such is the case. But I only admit it to this extent. The function is an acquired function, we might say that the vestabular mechanism is sort of a developed leader who has been taught its duties in innervation of the eyes, by long practice under the needs of visual control, to the extent that under certain conditions and without their oculo-

motor innervation will place the eyes in position to use.

The particular groups of innervations, numerous as they are, and important to our physical welfare, which affect the ocular motions under the control of the vestabular mechanism, are but a trifling part of the innervations handled constantly in the marvelously complex organ, the brain. In order that we may understand what is actually happening, let me call attention to the extreme accuracy, of adjustments necessary in binocular single vision. Not only have we a vertical and horizontal plane in which to work, but we have a pair of receptors mounted to turn in all meridians and capable of being turned on an axis through a wide range of angular motion. Every rod and cone in a given pair of eyes must be brought accurately in register with a corresponding mate to accomplish binocular single vision. So long as this condition is fulfilled we may say we have comfortable vision. Immediately we depart therefrom trouble begins.

Most people dread pain, and it is remarkable the measures that will be taken to avoid it. Small wonder then that the relief offered in the form of suppression is grasped avidly by most people, particularly when this is supplied without the knowledge of the individual. Modern conditions with their eternal rush through life, which starts even before school days, may best be illustrated by requiring scan reading, a faculty actually developed under instruction by the time one reaches college, if not before. This certainly develops careless habits of vision with inaccurate register of the form on the two maculea. Add to this the automobile with its sliding convergence from watching the road directly ahead to the complication of reading signs at the side of the road in this day and age when every family has an automobile or some good friend who has one, and the popular amusement, the movie, with its composite picture which depends on slurred vision for its effect, and we need look no further for the enormous increase in eye-strain patients we have.

The most pernicious offender is the road-side signboard. We admit you have to read them else there would be no complaint, but if the public at large looked on them as I do, popular demand would pull them all down in a week. Slurred vision leads to a careless register of maculea reception, careless register leads to careless innervation, which develops the tendency to deviation we know as phorias with pain as a syndrome, and, specifically, as they are all cousins, we are dealing with the cyclophorias, and as we all know, a cyclophoria cannot be tolerated long. Then, we rapidly develop a cyclotrophia and one of two things happens; it is intermittent, and we suppress in varying degree or total with vertigo, as the syndrome, or with other imbalance we develop strabismus for the relief.

Properly handled these cases all yield to treatment. Suspension and suppression is much more common than we realize. And here I drop a word of caution in the prescribing of glasses. Lenses alone

will not correct the trouble, if comfort is given in asthenopia where torsions are involved, it will in all probability be, because you have increased the tendency to suppress. It is this type of patient in which you find the complaint that they have to wear the correction, but never like it, and sooner or later when the suppression becomes a fixed habit, the lenses will be discarded altogether. They frequently go from one doctor to another, and on again. When you get a history of this sort, check up on it and if your patient suppresses, you must treat him, and I repeat if you treat suppression cases and dismiss them as corrected with the head resting in a fixed rest, check up on the case again. They may still suppress if you throw the vestabular into action by inclining the head.

I am guilty of coming before you with a very unusual idea. There may be something in it. The only reason that I consented to appear was that I think I have found out something that will come nearer answering the "why" of this, and the "why" of that, than any other one thing we have brought out. If you do not agree with me now I ask you only this: go home and try it out.

I have two photographs here of a patient 22 years old. The second photograph taken eight days after the first, and you can

FIG. 1

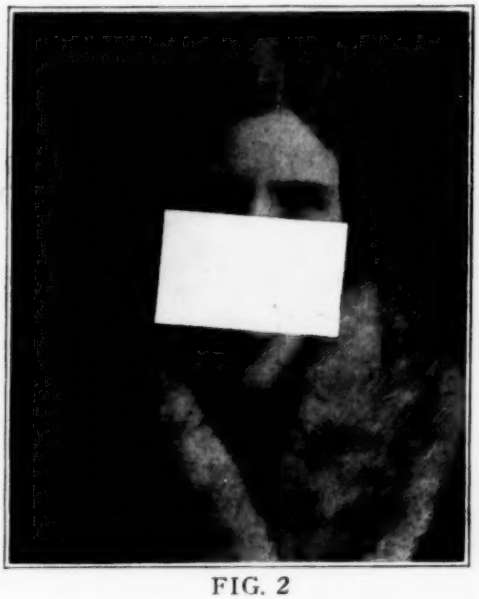

FIG. 2

see (Figures 1 and 2) the results. This patient saw 20/60 uncorrected. There has not been a lens applied. On the day the second photograph was taken she read 20/20, monocularly or binocularly. When she gets her attention on an object, her eyes are as straight as any, and will stay straight, but with one thing interfering and that is habit. Before the treatments her head was inclined

to one side constantly, and you would have said she was a hyperphore. Six months ago, I would have said the same thing. Today I do not believe it. In fact, so far as I am concerned, I am quite certain that she had nothing in the world but disassociation of fusion.

All this leads me to believe we have something here that is entirely new and that this body of men will give intelligent thought to this thing. I will follow it up, with the illustration I told you about, and the discussion of a case which came out of this experience.

Patient, E. E. N.; March 14, 1928; age, 28 years; ocupation, editor daily paper; history, no knowledge of parents or near relatives using glasses other than for presbyopic needs. Some two days past patient consulted an optometrist because of inconvenience in near point use of his eyes, which at that time itched, burned and were at times painful. He was fitted with a + 0.50 D. Sph., O. U. which were satisfactory and which he used constantly. Called to have a broken lens replaced and expressed a wish to have his eyes rechecked against a possible need. His pupils were large, the left slightly larger than the right. Torsions were approximately 10° to the right and left and equal in both eyes, but the motion to right was smooth while to the left it was irregular and jumpy. Suppression indicated. Check with F-L card reveals total suppression at occupational near point.

Ductions—No record of value obtained on account of suspension.
Skiametry—Static, + 0.50 D. Sph., O. U.

Treatment for suspension indicated and recommended to patient but was deferred for ten days.

March 24—Difficulty was experienced by patient recognizing the two letters (F and L) at the same time. Did obtain a record of the F superimposed approximately upon the E at 35 c.m. by use of 7$^{\Delta}$ prism base-down over right eye and 6$^{\Delta}$ base-in base over the left, (Note—Normal 10$^{\Delta}$ base-in O. U.) Both letters seemed in motion, roaming in all directions and one seemed smaller to patient than the other; the F also being apparently nearer him than the L.

Progress—Little change was noted until the third day when the patient was able to fuse an E for periods of about three seconds at a time.

March 26—He fused E for 15 seconds and much more readily.

March 29—He now fuses E readily and holds it at will, overcomes a reduction of prism power to 3$^{\Delta}$ base-down over the right eye, and 2$^{\Delta}$ base-in over the left, but tires after about ten minutes of treating.

March 30—He holds the E at will without prism assistance.

April 2—Patient reports pain and inconvenience approximating sick headaches on the day before (Sunday) but is feeling better

today and fuses the E to 5Δ base-out O. U., loosing control after exercise and only regaining by dropping back to no prism power.

April 5—On this date the patient fuses the normal 10Δ base-out readily and overcomes 7Δ additional with 1Δ base-up before the right eye, no suppression is noted for either distance or near use. No further record of daily treatments beyond this point were made on account of the rapid progress made to full range of duction power and patient was put on a weekly check until about July 5, when patient returned for post-refraction, reporting that he was experiencing some annoyance following his near work at his desk. Patient showed a tendency to right hyperphoria and experienced difficulty in attaining full range in ductions. Was put under temporary use of 1Δ prism, base at 45° for the right eye and 1Δ base-in for the left eye. Ductions rapidly developed to normal and patient started on his vacation. Since this the patient has been checked at regular intervals and is normal and comfortable without use of lenses.

Conclusions: Patient had never had binocular vision but had used the eyes intermittently. He had no tract habits to overcome and fusion was attained readily, becoming established and retained at all normal ranges. The fusion habit once established will be retained and the duction range will afford the patient comfort without the constant use of lenses.

With that case in mind I had a young lady come to me some time after that who had been to an optometrist according to her history chart every two months for two years. Glasses had been changed every time. She still had strabismus. The eyes turned out definitely. I had the pleasure of getting this girl's visual axis normal without a change of lenses before she got out of the chair, and in a week her eyes were straight and have stayed so. Here there was a direct involvement of the torsions. The therapy used in this case was simply Kratometer treatments given with base-in prisms, the patient's head, at the same time being in motion. That is, with the head being tilted from side to side as the treatment continued, as far as the apertures in the instrument permitted. The patient fixes the F-L card. No chin rest is used. For instance, 10 base-in prism is first placed in the instrument. Fixation at 39 c.m. with a red disc over the fixing eye. If the patient cannot perceive both the L and the F then tilt the head from side to side. In a surprisingly short time the patient will have diplopia, and then with the aid of other prisms can be made to fuse the E. From this point on it is merely a matter of oculo-prism treatment, constantly reducing the prism as the patient improves until binocular single vision is achieved.

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CHROMAGRAPHOLOGY

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Chapter VII.

Focal Infections

In the professions, as in the business arts, there still remains a backward element; and because of the inherent weaknesses of the human family, it is assumed that this will always be true. In Optometry, we still have remaining fakers and common "spec peddlers," but a great body of serious-minded, professionally inclined men are surging up and out to fields of greater service. We find them cognizant of the fact that many ocular disorders are reflected to various parts of the body, but in a greater degree, they must realize that the converse is true—namely, that a greater number of body affections are reflected to the visual apparatus. In a great many cases, the visual mechanism is so affected that trouble is readily discernible, but in a great many other cases, it is only recognized through careful, thorough-going, painstaking examination.

It is our purpose at this time to consider focal infections, and some readers, not fully advised, might wonder why such individual attention is necessary. Let us make it clear that there are those who would classify focal infection with tuberculosis and lues as the three most important of all infections. This is a surprising statement in view of the fact that only a short time ago the condition was described among clinical findings. It has grown in proportions until at the present time it is estimated that over 50 per cent of those entering our hospitals do so because of manifestations of a focal infection.

Dr. B. T. Hoffmann, of Chicago, Ill., has described focal infection as "a localized or circumscribed area of tissue containing pathogenic microorganisms, which may be primary or secondary in character." It is perfectly possible, however, that a secondary focus may become primary in action by distributing the infection to still other areas which would lead eventually to a general infection. The writer wishes to offer the following definition—namely, a focal infection exists when we have a circumscribed area of pus which may or may not have drainage. If it does have drainage, it is remotely possible that very little systemic absorption will take place; and in any event the systemic absorption will be reduced in direct porpor-

tion to the drainage. If there is no drainage, systemic absorption will take place, in which case the infection will be transported and the trouble registered at another point, sometimes quite remote. "A periapical abscess may give rise to an arthritis." With this definition in mind, all of the infectious diseases, including syphilis and tuberculosis, might be placed in the same category, and, broadly speaking, this is true.

Before going further in our analysis of the processes involved, it will be necessary for us to consider the general system and its mechanism. It has been very tersely said "the blood feeds the lymph, and the lymph feeds the cells," so that all the processes of tissue nutrition, and tissue repair are dependent upon the lymph.

The products of catabolism which are waste, together with the excretion of the cells, are carried back into the blood stream by the lymph, for the purpose of elimination. The lymphatic system might well be compared to vines following along through the body, the tree-like formation of the circulatory system proper. When we consider the circulatory system as a tree, we have one characteristic which does not follow the tree picture, in that the endings of the arteries and the beginnings of the veins anastamose through very small capillaries so that there is no real ending. However, the analogy of the vine as concerns the lymphatic system forms a marked contrast by virtue of the fact that like leaves on the vines, they end blindly at some particular point of the body, so that we find the entire body richly supplied with lymphatics. There are said to be three sets of lymphatic vessels and glands, namely the superficial or ectal, the deep or ental, and the visceral, i. e. associated with the various organs. The superficial lymphatic vessels follow the veins, while the deep-set follow the arteries. The flow in all cases is the same as the venous blood flow, namely from periphery to center.

Considerations of the production of lymph have brought forward varying opinions, the most general one being that it is purely an infiltration of normal blood plasma passing through the walls of the capillaries by osmatic action to which is added a secretion derived from the capillary endothelium, a product of cellular activity. Chemical analysis substantiates this opinion. Upon leaving the capillaries, it enters the inter-cellular spaces, bathing all the cells and supplying them with nutrient properties. The volume of lymph is surprisingly large, estimates ranging from $\frac{1}{6}$ up to $\frac{1}{3}$ of the total body volume. This can be better understood when we compare it with blood, ranging from $\frac{1}{20}$ to $\frac{1}{11}$ of the entire body volume. Having served its purpose, it immediately becomes burdened by the catabolic waste products and enters the end organs (capillaries) of the lymphatic system, and is ushered along to the nearest node, from thence along vessels ever increasing in size until it enters the thoracic duct.

"The common primary foci in the body are: First, periapical abscesses; second, pulpless teeth; third, peranasal sinuses; fourth, tonsils and adenoids; fifth, prostate and seminal vesicles; sixth, skin. It will be noted that all these foci are located in cavities situated close to the surface of the body." Noting this, we must see that when the pathogenic microorganisms commonly concerned in focal infections (usually streptococci

or staphylo-strepto-pneumococcus) in cases of infection, are added to the normal products of catabolism, the lymph is seriously vitiated. Upon reaching the nearest lymph node (small bean-like nodules nearly 600 in number, developed from a plexus or network of vessels, and usually situated in loose connective tissues) a stoppage is created by virtue of the fact that the node is not able to express this overburdened substance. It is, therefore, stored because the node is easily movable and can undergo considerable enlargement before symptoms of pressure are evidenced. Thus a secondary focus is established, and this may obtain in several locations. "The common secondary foci are: First, regional lymph nodes (just described); second, joints; third, tendons, ligaments and fascia; fourth, nerves and brain; fifth, appendix and gall bladder; sixth, kidney; seventh, heart muscle; eighth, eye and ear; ninth, stomach and intestines; tenth, lungs. It is readily apparent from this that there are few spots within the human body which are immune to the inroads of focal infections."

"As was already indicated, the primary foci are located either on the body surface, or else in one of the readily accessible cavities adjoining the body surface. Factors favoring the establishment of an infected primary focus are the same identical factors which predispose to infection anywhere, namely: first, weakness, resulting from previous infection (ex., prostate); second, mechanical defects (ex., nasal septum); third, trauma (ex., prize-fighters' wrists); fourth, exposure to cold; fifth, poisons of all sorts; sixth, defficient blood supply (ex., joints); seventh, senility, fatigue, starvation, etc. Here, as in all types of infection, the establishment of an infectious process depends on: First, the dosage of organisms; second, the virulence of the organisms; third, the resistance of the host."

The subject being obviously such a large one, we are prevented from dealing with it in its entirety even if that were possible, so that an effort will be made to confine our attention to some specific instances, namely: the most common. Clinical data indicate that 80 per cent of all infections originate above the neck. Careful compilation indicates 44 possible points of infection above the neck, 32 of which are teeth. This is a very definitely contributing factor to the close association which must be established between the stomatologist (dentist) and the optometrist, but it will be required of each that he be well fitted in his particular art. Here again, the weakness of the human element reduces greatly the number of men available in both fields. Of this we are well aware in our profession, and it is the constant challenge to education. Concerning the stomatologist, only here and there do we find him capable of securing indicative information with or without radiographic pictures. Nevertheless, it is being attempted, with the result that a great many focal infections have undisturbed residence in the box (head) that houses the ocular mechanism; and, as is usually the case, bad neighbors are troublesome, so that the visual apparatus is affected. Radiographic pictures (x-rays) to be used successfully require careful study and knowledge. Recently the writer sat under Dr. Paul G. Boynes, Professor of Periodontia at the College of Physicians' and Surgeons' in San Francisco, California. The subject of his work was "Dental Radiographic Interpretations," in which among other things, he

pointed out the importance of the angle of an x-ray, establishing the fact that many so-called negative pictures are so because the infected area is hidden by poor technique. Another point he established quite clearly was that exposure is extremely important, for the reason that here again over or under-exposure might rob the picture of its informative quality. So it is advisable for the Optometrist, in building up his inter-professional collaboration (so necessary to his own professional advancement), to establish connections with a capable stomatologist. This is not as easy a task as might appear on the surface. The writer believes that he speaks authoritatively, because after a nation-wide lecture tour, during which contact was made with all professions, he failed to find many men who practice stomatology in any other way than an out-of-date fashion which lacks the approval of advanced ideas. As expressed by one very famous man in speaking of extraction:

> "Common extraction means that the tooth is just simply pulled or 'yanked' out. When the tooth is out the operation is complete. No attention is given to removing infection, diseased bone or smoothing up rough process. It is the old way as practiced in bygone days originally by the barber, then by the country physician, and at the present time by those dentists who have not developed the skill to do the operation thoroughly or who are satisfied to do their work in a mediocre way.
>
> "Common extracting, then, in many cases means taking a dirty forcep out of a dirty drawer with a dirty hand and 'yanking' a dirty tooth out of a dirty mouth."

If this be true, then, of such an age-old operation as the removal of teeth, how then could this same type of man be expected to thoroughly understand radiographic pictures and their substantiation in an even more definite fashion by colour field analysis, an Optometric procedure?

It was the privilege of the writer to have very close contact with Dr. Menifee R. Howard, of Denver, Colo., and to really experience the scope of work possible from a dental standpoint. It is really distressing to realize how haphazard pure mechanical dentistry may be when it is compared with that of an able man. I am publishing herewith a letter from Dr. Howard, in order that the reader may have an idea of the subject of focal infection from the standpoint of the stomatologist.

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August 7, 1930.

Dr. W. Jerome Heather,
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Dear Dr. Heather:

Relative to our previous conversation and recent correspondence, I am sending herewith the desired information.

A focus of infection is a site where bacteria, against which the body has little or no local resistance, are flourishing locally. The organs most often affected are the teeth with their surrounding structures and the tonsils.

Foci may be grouped into four main headings: pyorrhea, apical disturbances, impacted and malformed teeth and residual areas. To enlarge

upon these, under pyorrhea we have numerous stomatic diseases, including trench mouth and pyorrhea, either general or scattered. Apical disturbances include, abscesses, granulomas, cysts and the resulting bone conditions. Impactions and malformed teeth may carry cystic growths, not parallel to the apical cyst. Residual areas include pieces of broken process, roots, granulomas or cysts, certain bone conditions and foreign bodies in sockets or tissue. These residual areas result from unfinished or careless surgery.

Pyorrhea, through its devastating processes to both mucous and bony structure, produces pockets which are typical places for the proliferation of bacteria and their toxins. These are ingested with the food, passing into the stomach and intestines where metabolism is more or less interfered with. Others are taken directly into the blood stream from the local site in the mouth. This is a constant drain, never letting up until the condition in the mouth is treated and cleaned up. Abscesses, granulomas and cysts, may be grouped together. With these a certain amount is taken directly into the blood stream through the local viscular system and some is forced into the circulation by the inflammatory process under pressure. Many of these areas are, through nature's efforts, walled off with a condensed bone but even so a certain amount finds its way into the circulatory channels.

Residual areas may continue to generate their harmful products, pouring them into the system with no appreciable decrease in the trouble for which operated. Impactions may cause nerve pressure, resulting in mental disturbance, eye disorders, constant headaches, etc. The soft tissue pocket around the crowns of these malformed, impacted or embedded teeth harbors bacteria from the mouth along with accumulating food debris.

The first signs of focal infection may or may not carry any local disturbances in the way of pain, in fact, the large majority of teeth causing systemic disorders have never given the patient any noticeable local trouble. If this primary focus were painful, it would ease the troubles of both the physician and the dentist.

Once a secondary focus of infection has been established, it is theoretically and often practically impossible to expect eradication of the organisms by attacking the primary focus. However, to clean up the primary focus will prevent the continuance of filling the blood stream with the bacteria or toxins capable of enhancing the power of the secondary foci already established and the production of new secondary foci.

Sincerely hoping that this serves its desired purpose, I am most
Respectfully yours,
(Signed) M. R. HOWARD.

Of course, we have other infectuous possibilities to consider such as tonsils, the sinuses, as well as the ears. It must be remembered, however, that in a great many of these cases the ocular symptoms produced will be easily noticed, and yet, in a great many cases, they will not be. Here, then, is the importance of colour field charting in that accumulated data gives conclusive evidence that in cases of focal infection, the field for green is definitely constricted. We have urged that in the charting of colour fields comparative values be stressed by associating two readings taken within the same 24 hours. It might be of interest to the reader to know that unless an intoxication of large proportions enters into the picture, the green field, in cases of focal infection, would be definitely constricted throughout the entire day. This is so certain that sometimes only four points are required to complete the green field because of its size.

The California Research Group in the Science of Vision, which was founded under the auspices of Optometry, is probably our most advanced

Optometric Association in that all of the professions unite in securing information from every point of view that concerns vision. The writer, a member, was privileged to have very pleasant contact with Dr. Thomas A. Brombach, and through him, Dr. F. Vance Simonton, former Professor of Dentistry at the University of California. Dr. Brombach's fame is deservedly nation-wide, particularly for his splendid work in colour field charting and diagnosis. A great deal of his colour field evidence has been secured by the collaboration of Dr. Simonton; and the following is an excerpt from one of Dr. Simonton's papers entitled "Perimetric Diagnosis of Dental Infection," and it should be of extreme interest to all Optometrists progressive enough to be using colour fields as a part of their diagnostic studies:

"Dental infection which does not drain directly into the mouth, but which is confined within and drains into the tissues as in granulomata, areas of rarefying osteitis, chronic alveolar abscesses without sinuses, may be indicated by restricted green fields.

These diagnoses are strengthened by findings of low tonus of ductions, and sluggishness of pupillary reflexes.

In the perimetric diagnosis of dental infection it is necessary for the Optometrist to make every effort to assure himself that the true field is not obscured by factors which have been overlooked. Thus the restricted green field associated with a case of apical abscess may not be revealed until the stimulative efforts of coffee and tobacco have been eliminated. Examinations of the mouth must be made with great care in order to safeguard against overlooking areas of pathological tissue or of bacteriological infection.

If the Optometrist makes a perimetric diagnosis of dental infection of the oral drainage type it is necessary to search for pyorrheal lesions, discharging abscesses, abscessed roots with open canals, discharging residual infections. Mouths which appear normal on preliminary examinations have been found on more careful study to be seriously affected with pyorrhea. Pyorrheal lesions may be associated with imbedded and impacted teeth, with retained root fragments and with other residual infections.

If the Optometrist makes perimetric diagnosis of dental infection of the locked or centripetally drainage type it is necessary to search for pathological areas about the ends of pulpless teeth, for pulpless teeth in general, for dying pulps, for locked residual infections, and any abnormal osseous areas to be discerned in the x-rays.

There are four types of chronic dental infections which may be associated with systemic disease:

1. Chronic infection about the ends of the roots of dead teeth.
2. Pyorrhea and pockets around partially erupted teeth and under reconstructive appliances.
3. Chronic pulp infection in live teeth.
4. Residual alveolar infection after tooth extraction.

In collaboration between Optometrist and dentist, it is necessary to recognize that most of the patients of the former will present positive symptoms while many of the patients of the latter will be symptomless.

If symptoms can be regarded as evidence of lack of tolerance and lack of symptoms as evidence of tolerance of infection, then it would be expected that symptomless cases of pyorrhea or apical infection might be perimetrically negative. This problem needs research.

There are no tests available at present to determine tolerance or lack of tolerance of dental infection; neither, differential blood counts, blood chemistry, nor bacteriological methods have been found of use, consequently if perimetric examination can be employed for this purpose it will

be of the utmost significance to the subject of focal infection.

The objection has been raised that color fields are not consistent. Evidence will be presented that they are consistent. It is interesting apropos of this subject that a standard textbook for medical students, Howell's Physiology, makes the following statement (7th Ed. P. 357) 'the color sense (varies) with each individual, so much so that it is possible that a test of this character (perimetric) might be used for the identification of individuals.' This statement indicates that the author believes color fields are consistent. It fails to consider the later findings on perimetry, which is to be expected since these data have only recently been available.

Evidence will be presented of dental infection diagnosed by color fields and of color fields corresponding with dental infections.

Evidence will be presented of the necessity for great care in searching for all the factors which may complicate or obscure the perimetric findings.

DENTAL INFECTION DIAGNOSED BY COLOR FIELDS REFERRED TO DENTIST BY OPTOMETRIST

Patient: Mrs. J.—Shows interlacing. By process of elimination Dr. Brombach diagnoses pyorrhea. Preliminary clinical examination of mouth did not reveal pyorrhea, in fact, the investing tissues appeared unusually good. X-rays were taken. These showed extensive pyorrhea about the lower left first molar and in the molar regions generally. Careful clinical study now revealed considerable involvement, the pockets bled on probing. The case was treated effecting clinical improvement and the color fields became normal.

This case also presented two pulpless teeth, one with apical rarefaction. The color fields at this time were negative for apical pathology but search of the files revealed chart taken in the year previous which showed the characteristic restricted green field. It is suggested that at that time tolerance was low whereas when later charts were taken tolerance was adequate.
Patient: Mrs. T. A. B.—Color charts April 9, 1929, showed interlacing right side; severe neuralgic symptoms this side. Extracted abscessed root of second bicuspid from upper right side April 12. This infection was draining into the mouth through an open canal. Could not curette on account of hypersensitive condition and failure to respond to anesthetic. Chart April 13 showed interlacing; right eye. This eye did not become normal until April 29, probably because of slow elimination of residual infection. On May 13 there was interlacing in both eyes associated with coryza.

PATIENT REFERRED BY DENTIST TO OPTOMETRIST

Patient: Mrs. V. McC.—Many abscesses and chronic antral infection. Color fields show restricted green. The ductions and reserves were low. Dr. Brombach diagnosed alveolar abscess.
Patient of Dr. Peachey. Color fields May 9 showed restricted green. Patient has three pulpless teeth, one positive radiographically."

We have mentioned only one way whereby the products of focal sepsis may reach the eye, namely: through lymphatic absorption which, because the lymphatic system is a closed system, must eventually give ocular demonstration even if in no other way than affection of the colour fields. It may be also accomplished by blood-borne bacteria or by created toxins borne by either the blood or lymph. Further, because teeth have proven the most liable foci, we have expressed that in detail, mentioning, however, the other possibilities. It is the purpose now to step away from the method of conduction, also from the specific foci and classify them all under the heading of focal infections.

It is possible, and extremely likely, that any one or more of the following ocular involvements may be found in association with focal infections—blepharitis, meibomian cysts, chronic conjunctivitis, episcleritis, dacryocystitis, corneal ulcers, iritis or cylitis, and probably many others. These, however, could be associated with other causes, or could exist as a primary infection. The degree of intensity will be dependent upon—"First, the virulence of the infective organisms—that is, the intensity of attack; second, the volume of toxins absorbed—that is, the extent of the attack; third, the time-factor—that is, the duration of the attack; fourth, the resistance of the body—that is, the defense."

Another possibility exists namely, that there might not be any noticeable ocular condition present; so that we face the necessity of having in our diagnostic procedure some feature which is sure. To this end *Chromagraphology* presents colour field charting, by saying that in every case where a focal infection exists it will be demonstrated by a definitely constricted green field. Further, if the infection has existed for a period of time (24 hours or more) sufficient to allow general systemic absorption, the field for red will also show a depression. Someone, trying to deny the strength of the foregoing statement, might possibly bring forward a counter statement that some other intoxication, either of a stimulating or depressing type, might hide the green field constriction. In answer to this, it is definitely stated that in cases of auto-intoxication where the fields do not recover after a period of rest, the green field constriction will not be covered over, but, to the contrary, will stand out quite definitely. In the case of a transient intoxication following a period of rest, the fields will return to approximately their expected normal with the important exception that the green field will show a constriction in the presence of focal infection.

The accompanying chart Figure 1 shows the type of field which may be expected in the presence of focal infection, as it would be found without other intoxicating factors. Here is shown the constricted green field as explained before, and the reduced red field expressing the toxic effect on the entire system. For easy comparison, let us observe the eight main meridians as follows:

RIGHT EYE	0°	45°	90°	135°	180°	225°	270°	315°
Expected normal—green	26	21	17	19	23	22	22	23
Constricted—green	10	10	12	10	8	7	10	11
Expected normal—red	41	26	20	23	27	28	28	32
Constricted—red	17	14	16	20	17	17	16	23

The writer deeply appreciates the value of Dr. Brombach's position in field-charting, and is entirely in agreement with the following excerpts from his lectures:

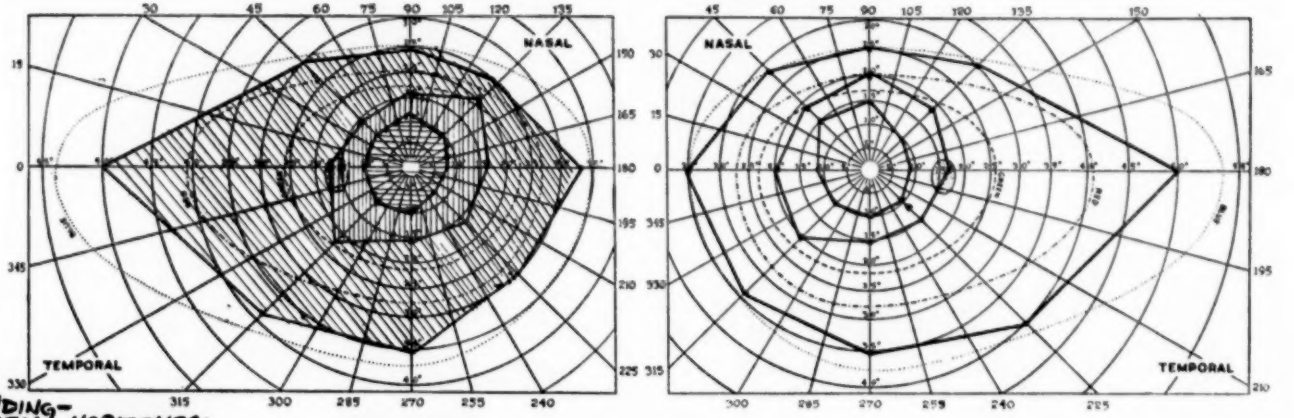
> "Optometric interpretation of color fields may well take the place that x-ray analysis occupies in dentistry.
>
> If the introduction of a toxic agent from without is eliminated, a seven to eight hours sleep will indicate a negative color field.
>
> The co-operation of the physician, surgeon, and dentist is of vital importance in all cases of endogenous toxemia.

TANGEMETRIC CAMPIGRAPH CHART

CASE NO. 103.

Name X. Age - - - Referred by - - - - - -

Date Sept. 15 - '30 Hour - - - Complaints None



SHADING -
GREEN - HORIZONTAL
RED - VERTICAL
BLUE - OBLIQUE

RIGHT EYE VA UNCORRECTED ✓ CORRECTED ✓

LEFT EYE VA UNCORRECTED ✓ CORRECTED ✓

Diagnosis Focal Infection - Systemic Toxemia

Prognosis

Disposition Stomatologist

APERTURE USED:
SMALL
MEDIUM ✓
LARGE
FORM

©1928-CAMERON'S SURGICAL SPECIALTY COMPANY - 666 WEST DIVISION STREET - CHICAGO, U.S.A.

Figure 1.

PRINTED IN U.S.A.

The service of the Optometrist does not end after the patient has been referred to the physician, surgeon, or dentist.

Systematic charting of the fields and comparative measurement of the stimulus of the various ductions will offer tangible evidence as to the progress made in whatever therapeutic or surgical measures for relief are employed.

This brings us to a consideration of the means at our disposal for diagnosing chronic focal infection. These means are yet quite unsatisfactory. There are a few tests of a general nature, that we may apply in an effort to determine the existence of a focus but these are by no means generally accepted as valid.

The blood picture, differential count, uric acid content, tests for antibodies have been studied with negative result.

Realizing the unreliability of these tests and the absence as yet of any others, one is much impressed with Dr. Brombach's data. If an optical method can be used to determine the presence or activity of a focus of infection, it will be a most signal aid in our treatment of disease.

In conclusion, the importance of tests of color vision to the dentist himself. Doubtless difficulties in matching colors of teeth often due to toxic effect from coffee, tobacco or other poisoning. Dentists would do well to have their color fields taken to determine such conditions and if present to ascertain their limit of tolerance.

Twenty-four hours after the extraction of a septic tooth and elimination of the alveolar abscess, decided field recovery are measurable.

Proper Optometric hygiene consists in elimination of the causative agent of improper physiological function of the human eye before preventive or corrective measures are prescribed."

The definite usefulness of *Chromagraphology* as expressed in this chapter should again be encouraging to those following its interesting and useful development, but at the same time, should act as a spur, urging into larger fields of service those in our profession who are lagging behind.

CORRECTION: In the April issue of this Journal, Chapter Three of the article entitled CHROMAGRAPHOLOGY, please note the following correction. The words listed below (which appeared in the April issue of this publication) should have been enclosed in quotation marks:

Page 230—Line 29: "most, if not all animals begin as single cells,"—

Page 230—Line 36: "Hence special areas grew in sensibility to external influences,"—

Page 230—Line 41: "The continued existence of the animal."

AN OPTOMETRIST'S BAG OF TRICKS*

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Modern optometric tests are, on the whole, fairly complicated, which is but natural since the optometrist's aim at this stage of our development is to obtain *precise* findings. Simple tests that give only approximate findings are being more and more neglected. And yet there are occasions when such simple tests come in very handy. When an optometrist for instance wants to make an approximate diagnosis of the refractive and muscular condition of an eye without the facilities of his office equipment, he can readily do so with these simple tests since they require practically no instruments.

A personal experience will illustrate the foregoing. On one of my trips to Europe I made the acquaintance of a French gentleman. He had spent some seven or eight months in the United States and was now returning to France. With my limited French and his limited English we got along pretty well and had frequent discussions on topics of all kinds. Once he remarked on what he regarded the excessive cupidity of the American professional men, mentioning especially optometrists and dentists. He claimed, and with sufficient evidence, that there were more dentists in one large city in the United States than in the whole of France. He believed this was due to the dentists urging the people to come in for frequent examinations and always finding a cavity or other needed dental work. Likewise, he remarked, there were more people wearing eye-glasses in New York City alone than in the whole of Europe. This too was due he ventured to the zeal of the American doctors in prescribing eye-glasses.

I appreciated the partial truth of his statements and readily agreed that there was probably much more dental work done in the United States than anywhere in Europe. I also confirmed that there are many more people wearing eye-glasses in the United States than in any other part of the world. But I tried to convince him that this was due largely to the fact that the American people are accustomed, sometimes with a little urging, to take better care of themselves. They therefore pay more attention to their teeth and to their eyes. In Europe, I maintained, there are probably millions who need eye-glasses, but are not aware of the fact and struggle along. He then facetiously remarked that, perhaps, if he were

*Submitted for publication April 24, 1930.

examined by an American specialist he, too, would be given eye-glasses though he could not imagine that he needed any. And now comes the point of the story.

I had taken no eye-examining instruments with me, but with a piece of cardboard I made a simple test on his eyes and found them to be myopic. As I happen to be myopic myself, I placed my lenses before his eyes when he was readily convinced how much clearer and further his vision became. The minus lenses enabled him to read a bulletin about ten feet away, which without them appeared to him as a paper with a lot of blotches on it.

By another simple cardboard test I found that he was markedly exophoric. Now occasional diplopia especially after doing much close work is a common symptom of exophoria. So that when my test revealed him to be exophoric, I remarked that he probably had periods of double vision, especially after using his eyes for long periods at close range. This he readily admitted and was rather impressed with the skill and knowledge of the American specialists. He wound up by saying that he would surely have his eyes attended to when he reached home.

Now any optometrist anywhere can make these simple tests, which require practically no apparatus and incidentally score conspicuous success. I will describe three of these tests. If you take a piece of cardboard, such as your professional or visiting card and pierce a small hole through it, just a tiny pin hole, you have the necessary apparatus. Have the person to be examined look through this pin-hole card at a distant target, such as a small light. A bright star, a bright button, a small door knob, or in fact any small bright object will do. While he is looking at the light instruct him to move the card slightly up and down or side to side and to watch whether or not the light seems to move as the card is moved.

If the light appears to be stationary, his eye is emmetropic. If the light moves in the same direction as the card, that is the light moves up when the card is moved up and the light moves down when the card is moved down his eye is myopic. If the light moves in the opposite direction to the movement of the card, that is, the light moves down when the card is moved up and the light moves up when the card is moved down, the eye is hyperopic. Similar observations are made with the card moved from side to side. The more extensive the apparent movement of the target the higher is the error. If the movement of the target is more extensive in one direction than in the other, say, in the vertical direction for the up and down movement than in the horizontal direction for the side to side movement, then the eye has unequal refraction in its various meridians, in other words, there is astigmatism.

This test, which has been called "Kinescopy" by Holth is more or less a crude test. Small errors will not show up readily. Often because of some accommodative activity the emmetropic eye may notice a slight "with" movement of the target, a movement indicating myopia. But as an approximate test requiring no instruments and no special skill it surpasses anything else in the field of refraction.

Another test for refractive errors, which is a little more complicated, is as follows: Make two pin-holes in your card, 3 or 4 millimeters apart. The two holes must be just far enough apart so that both may fall within the pupillary opening when placed before the person's eye. If the person has large pupils the openings may be made further apart when the test will work better. If the person has small pupils, so small that the openings in the card must be placed nearer than 3 millimeters in order to fall within his pupil, the test will generally not prove workable.

Assuming that the individual's pupils are of a size to permit the test being made, have him look through the two pin-holes at a distant small light. If he sees a single light the eye is emmetropic. If he sees two lights, one above the other when the openings are placed in a vertical direction, or one alongside the other when the openings are placed in a horizontal direction, he is either myopic or hyperopic. To distinguish between the two, take another card, and while the person sees the two lights, say one above the other slide your card so as to cover the upper opening. One of the lights will then disappear. If the upper light disappears when you cover the upper opening, the person is myopic; if the lower light disappears the person is hyperopic. Similarly when you cover the lower opening.

This classical test, known as Scheiner's test, is also but a rough test, and usually more difficult to perform than Holth's kinescopy test. But it can be refined to give a great deal of very valuable data. In fact, the optometer of Thomas Young, who contributed so much to the science of physiologic optics, was constructed on the principle of this test.

The third cardboard test is to find the presence or absence of muscular balance in the eyes. Take your card as it is, without any holes in it. While the person is looking at a distant small light, say a bright star, pass the card from one eye to the other and back again several times. As you do so ask the person to watch whether or not the light moves as the card is moved. If the light remains stationary as the card is moved the eyes are in balance, in a condition of orthophoria. If the light moves "with" the card, i. e., as you move the card from right to left and back again, the light moves from right to left and back again, the eyes are exophoric. If the light moves "against" the card, i. e., as you move the card from right to left, etc., and back again the light moves from left to right and back again, the eyes are esophoric. In vertical imbalances the light will seem to move up and down, and in compound imbalances the light will move along a diagonal, embracing a vertical and a horizontal movement. The more extensive the apparent movement of the light the higher the imbalance.

This test is a rather delicate test and is called Duane's parallex test. However, the names of these tests do not matter. The point is that they can all be made very easily anywhere in a few minutes.

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EYESTRAIN AND GENERAL PHYSICAL HEALTH*

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My paper tonight[1] is on the subject of Eyestrain and the relation between this and general physical health. The neurologist has pointed out that the patient must be relieved of all physical and mental irritants to make his treatment successful and I believe that this also holds true in the treatment and diagnosis of disease in general, and it is highly probable that the somatic stress induced by eyestrain is a factor worth considerable attention, for there are many sufferers from what we generically classify as nervous disorders, whose whole trouble springs from eyestrain. Unfortunately the medical schools give none or very little instruction in the ocular functions. So, the graduate enters general practice with no knowledge of the damage that may ensue from uncorrected refractive error and binocular incoordinations. It is, indeed, a sad mischance that the average physician has no more knowledge of the mechanism of ocular functions than has the intelligent layman. Even in some of the post-graduate schools in ophthalmology, less attention is given to refraction and the functions of sight than to ophthalmic disease.

To a group of physicians in general practice, as this present, it is scarcely necessary to point to the fact that many times these disturbances have their genesis in some irritation of an organ far removed from those in which the symptom presents itself.

For example, we have a few isolated cases of chorea (St. Vitus Dance) benefited by the application of the correct glasses and here is a field in which very little investigation has been made. Few of these cases are referred to the eye specialist for refraction and it is possible that in those few cases no earnest effort is made to determine whether or no there is a high latent error that may prove a disturbing factor, nor is it probable that there is often a close follow-up in many of these cases. We find those afflicted with amnesia, loss of memory in many instances, to be suffering from eyestrain of the most pronounced type and who shall say that correction of those binocular imbalances might not have enabled those individuals to withstand other nervous disturbances that finally led to their breakdown. We find instances, without number, of migraine, chronic dyspepsia, constipation, intestinal pain, directly traceable to eyestrain and relieved by proper glasses or ocular exercises without further medical

*Submitted for publication May 22, 1930.
[1] Read before a group of Michigan physicians.

treatment. And we find still a greater number of cases that resist all efforts of the physician until the stress of eyestrain is removed.

Thirty years ago, Hazen stated that 30 per cent of the inmates of insane asylums and sanitariums were there because of uncorrected eyestrain; a statement received at that time with laughing incredulity; yet today, in the light of better knowledge, we cannot deny the plausibility of Hazen's assertions. In view of the alarming increase of mental and nervous diseases, the outcome of this era's industrial demands, the physician can neglect no possible source of nervous irritations, nor should he overlook the eyes as a possible source of trouble.

And this is more necessary with patients whose occupation demands several hours daily at close work. For the mechanism of vision was developed in the environment of out-of-door life, with visual attention and fixations at distances of at least several yards, more often at much greater distances and with seldom more than momentary use at what we now term the near point. Yet within the short span of a couple of generations we have so modified our existence that nearly all our gainful occupation is carried on with the work within arms' length; hours of unceasing attention at this close point are required. While there are a few individuals able to carry on such work without difficulty, the vast majority have not yet reached that stage in ocular evolution where their eyes can maintain, without fatigue, fixed adjustment at close work.

The last few years have brought us much knowledge, to replace that guesswork of the past. While we know that we have not solved more than a small part of the great problem of eyestrain, yet we feel that we have arrived at certain fundamental principles and that we are now on the highroad to an objective. The two great causes of eyestrain, as we have long known, are Latent Hyperopia and convergence insufficiency. But we have lacked both the knowledge of their cause and the means of correction.

Some of the symptoms not thought of in connection with eyestrain are: Malnutrition in children, poor appetite with Anorexia. There have been astonishing results in seeing children develop in bodily and mental vigor after being fitted with proper glasses; during violent headaches from Hyperopia, usually adults experience an absolute loathing of food, even water; car-sickness, usually due to convergence insufficiency; dizziness, sometimes, in extreme cases accompanied by palpitation and complaints of heart pains; sensations of nausea and fainting while moving through crowded stores or thronging streets; headache on the day following a motor ride or a visit to the movies; early morning headache after an evening spent in reading; insomnia; chronic indigestion; chronic constipation; momentary sleepy spells, characteristic of latent Hyperopia; and we have seen many cases of acute mental distress, absolute hysteria, relieved by correction of the causative eyestrain; migraine is a typical eyestrain trouble; occipital headache has not been generally associated with eyestrain, but it is frequently due to the difficult fusional adjustment required in esophoria.

I am not attempting to say that in every case presenting these symptoms the genesis lies in eyestrain, but eyestrain as a causative factor, or as an associate in the etiology of these disturbances, has not received proper recognition.

Latent Hyperopia has been the bane of refractionists from the earliest days of spectacle fitting. The necessity of disclosing and correcting this error has been fully recognized, but since the cause for the persistent latency, the mechanism by which the error was compensated, was not well comprehended, efforts to make the error manifest and correctible have not been very successful.

Before proceeding to discuss the mechanism by which the Hyperopia is covered, and the newer methods by which we can disclose it in full, I think, since most of us are not eye men, that we should define some of the terms in our technical phraseology.

The Emmetropic eye is an idealism which probably does not exist. Structurally, such an eye would be of that form and refractive power that, with the accommodation suspended, rays of light from infinity would focus exactly on the retina.

Accommodation is the activity of the ciliary processes by which the crystalline lens is made more convex, compensating by its increased refractive power, for the Hyperopic error and bringing the rays to focus on the retina.

Convergence is the faculty by which two images are brought to identical points and mentally fused and interpreted as one. The ideal structure is that in which convergence and accom. are so innervated that fusion and sharp focus are accomplished with a synergistic combined action impulse.

Hyperopia, is that error of refraction, usually referred to as Farsightedness. It may be due to a so-called short eye or the insufficiency of the curvature of the dioptric media. Such an eye is nearly always in a "constant" state of accommodation and strain.

Myopia, is that error of refraction usually referred to as nearsightedness. The eye may be anatomically a so-called long eye or the error may be due to or be the result of one of several diseases.

Astigmia, is that refractive condition in which light is refracted unequally in any two meridians of the eye and may be either Hyperopic or Myopic.

Presbyopia, is old sight. There is no exact age when this condition may set in, but usually is manifested in people at about 40 to 45 years of age. It is due to the sclerosis of the crystalline lens which loses its elasticity and which lessens its adaptability to accommodation.

Esophoria is the tendency of the visual axis to deviate inward and Exophoria is the tendency for the visual axis to deviate outward. The newer theory is that a phoria is merely the placement of a pair of eyes by the brain conditioned by habitual fatigue.

The accommodation is a part of the involuntary system and the convergence is of the voluntary system. In some persons, the two functions are so closely associated, so intimately connected that they are practically inseparable, and in all fairness, we can say that the central system controls them in synergism, although they are of different systems. It seems to be a voluntary function in control over an involuntary function. The intimate mechanism of this control we know nothing about, but we have clinical and experimental proof of its reality.

The ability of the accommodation to compensate for hyperopic error is rather limited. If the error is too great for the accommodative resources some individuals can call the convergence to aid and the error is covered by this convergence, what is called controlled effort.

When the synergistic accommodating-converging impulse brings about fusion and focus, we call the position of the visual axis "accommodative orthophoria." And the eyes appear to be emmetropic, though, in fact, they are structurally hyperopic and exophoric. The refractive error, being covered, is called, "Latent Hyperopia." The Exophoria also being latent, is now termed "Latent Exophoria." And wherever there is a latent hyperopia, there must be an accompanying latent exophoria.

When the convergence-accommodative impulse brings the visual axis to the orthophoric position, that is, where fusion is accomplished by this synergistic impulse but this innervation fails to cover all the hyperopic error, then that uncared for part of the hyperopia is readily discoverable, easily corrected by convex lenses. This uncovered part of the error is called the Manifest hyperopia.

Correction of the manifest error does not always relieve the person from eyestrain. It is the latent error and the effort to hold it covered that is the trouble maker.

If the error does not exceed the normal accommodative resources, if it is not so great but that the required innervation may be supplied through the regular involuntary channels there seem to result no untoward visceral reflexes. It is when this error exceeds the involuntary accommodative resources and the convergence is called upon to induce the excess accommodative effort that we get these disturbances. If the structural conditions are such that there is a low exophoria, with a small amount of convergence needed, together with a high hyperopia and a large amount of accommodation required and if the convergence is called on to carry the accommodation to summation, the convergence must over carry and the visual axis will carry past the fusion point, and we have the condition known as "Accommodative Esophoria." At this point the accommodation must be held tense while the convergence is relaxed back to the fusion point. This is a most difficult effort and usually results in headaches and stomach disorders, of the most distressing type.

If the exophoria is of high degree and the hyperopic error is of low amount, so that the convergence requirement exceeds the accommodative need the synergistic impulse may only extend its control to that point at which the accommodative need ends, leaving convergence to

travel the balance of the way to the fusional point without the accommodative aid. This condition is called "Accommodative Exophoria" and there is seldom any strain connected with this error. The fusional adjustment is made easily and the hyperopic error is seldom great enough to call for any excessive accommodative labor. Or, if it is, the individual goes about with blurred vision rather than to call into action the voluntary function of convergence to drive the accommodation to compensate for the error. Usually, the synergistic impulse is not strong enough to cover more than a part of the hyperopia and the larger part of the refractive error is manifest and easily corrected. In these particular cases, if synergism does cover a considerable amount of the error, the functions are easily separated by the occlusion of one eye or by the use of atropine.

But in cases of manifest accommodative orthophoria or accommodative esophoria, the convergence control is so stubborn that it will not give way to either monocular occlusion or to a cycloplegic. Atropine or any other powerful cycloplegic, will release some of the accommodation, but only a small part. Occlusion, even for many months, will only cause the stubborn convergence to relax but a little its tenacious grip.

It is the belief, unsubstantiated by proof, that atropine would reveal the full static error, that has led many of us into the pitfalls of false treatment of these cases, or too often, led us to dismiss the patient with the statement that the refractive error was fully corrected and any troublesome symptoms still persisting were due to some other cause. But so long as the accommodative effort is left unchecked, all treatment for the symptoms displayed will be futile.

We have noticed that these individuals with a manifest esophoria and many of those with an orthophoria, in which a high latent hyperopia and latent exophoria are covered, are of a dominant, self-willed, determined, ambitious temperament. We have never yet seen a lazy person with a high latent error. Perhaps that explains the failure of atropine to disclose the full latent error in these cases.

The accommodation can be relaxed, the full static error revealed, by mechanical relaxation of the convergence. That is, by using prisms base in, the convergence can be suppressed, the eyes turned to their normal exophoric position and the accommodation, lacking that support, usually relaxes and permits the uncovering of the full error. This method has the advantage over the use of atropine in that the patient is not left with blurred vision and its attendant discomfort.

This theory, that the accommodation could be relaxed by suppression of the convergence, using prisms, has been known for many years. But practically we are unable to get out more of the latent error by this method than by atropine. The reason was that we lacked the equipment for handling the prisms. Loose prisms, set in a trial frame, avail little. The rotary prism gave very little help. Some few years ago, we ran across the Hazen Kratometer, an instrument first built some 20 to 25 years ago, but never really appreciated by eye specialists.

Experimenting with this, it was found that by using Hazen's principle of "Break shocks," by prismatic jumps of the image, more could be accomplished than with either loose prisms or the rotary prism. The old instrument was rather inadequate and was rebuilt and improved and it gives us the equipment we need to put this theory into practical use.

In these cases of esophoria where there is a corneal astigmia, almost invariably this is partially or wholly compensated for by meridional contraction of the ciliary, or sectional accommodation. This contraction not always gives way to atropine, so that a patient may be left with the astigmatic error partially corrected. But by the means of the convergence suppression method, the ciliary contraction gives way more easily and there is more chance that a full cylindric correction will be accepted.

Where the structural condition is such that convergence requirements exceed the accommodative, that is, in a high exophoria with a low hyperopia, if the association of accommodation and convergence is very rigid, the excess amount of convergence needed for single vision may carry the accommodation past the retinal focal point and bring the rays to focus on a point anterior to the retinal plane. Thus is produced a pseudo myopia; often mistaken for true myopia.

If this false diagnosis is made and concave lenses prescribed for the correction of the manifest error, the case invariably develops into a true myopia and frequently into the malignant progressive myopia, so dreaded by all conscientious refractionists.

A typical case is presented by a man of 30, apparently myopic, fitted under atropine with weak concave lenses. A few weeks after obtaining this correction, he began to suffer severe pains in the right abdomen. Two physicians diagnosed the case as appendicitis. A third physician felt dubious about this diagnosis and referred this patient to another refractionist (of the optometric school) by relaxing the convergence, a high hyperopia was revealed and corrected. The pain diminished, symptoms finally disappeared and there has been no recurrence.

A young woman, about twenty-eight, when I met her, had suffered for years from the most dreadful sick headaches, which came on at intervals of from 6 to 8 weeks. She would be forced to go to bed for several days at a time. Extreme nausea, vomiting and loathing of food always accompanied these attacks. Physician after physician was consulted, but no relief found. On examination I found considerable esophoria at distance with a convergence in sufficiency at near. She had worn glasses for about fifteen years and had copies of all her Rx. Some for weak convex lenses, some for concave, some called for astigmatic corrections, others omitted them. I found a high degree of corneal astigmatism, masked by the con-acc. effort. Vision was above normal. After suppressing the convergence, the full correction for the astigmatism was accepted and quite a high amount of hyperopia disclosed. Correction of the error has brought relief, when this patient last reported, no more discomfort was being experienced and her physician has discharged her as cured.

Such instances could be cited ad infinitum.

The difference between this method and the older custom is, that formerly we attempted to relax the accommodation not realizing that what we falsely termed "accommodative spasm" was due to convergence control. Now, knowing this, we suspend the convergence and the accommodation is automatically relaxed. The method is easier, takes less time, and we discover more latent error than by the old method.

Esophoria is the most difficult of all eyestrains to correct, and is the most fruitful of physical, nervous and mental disorders. These disturbances are not amenable to medical treatment so long as the latent hyperopia remains uncorrected. But remove this strain and your treatment brings quick relief. The esophoric person always has good vision, usually above normal, this is due to the contraction of the pupil following high convergence effort and further contracted mechanically by the anterior bulging of the crystalline. You will note, as a sign of esophoria, that the pupil is abnormally small, particularly in adults of presbyopic age. And because of this extraordinary good vision, which he has learned is usually better than his confreres', he refuses to admit that he is subject to eyestrain or needs any attention ocularly.

The other great source of stomatic stress due to eyestrain, is convergence insufficiency. This is the inability of the individual to easily and without conscious effort fuse the two images seen by the two eyes into one clearly defined mental picture. Convergence insufficiency was for long thought to be due to muscular anomally, so we had a period of tenotomies and tuckings but most all these operative measures proved failures.

Convergence insufficiency is not a structural defect, but a functional difficulty, and is now known to be entirely of phylogenetic origin.

Convergence, single vision from the fusion of the two retinal images, is one of the last steps distinguishing the anthropological biped from the quadruped. And convergence, and the association of convergence and accommodation are the last steps in the evolution of human vision.

Convergence is not an innate heritage of the species. The human child is not born with control over the horizontal associations of the ocular versions. These he develops individually, experimentally, and often fails to develop them properly. The evidence would warrant us in assuming that the functions of binocularity are still in an evolutionary state, and may account for the many vagaries we encounter.

Convergence insufficiency is due to arrested, or immature development of the faculty of convergence. It is an unfortunate heritage of the visual habits of or primordial ancestors, to whom convergence was unnecessary and unknown.

Accompanying convergence insufficiency is usually what seems to be a low amplitude of accommodation. This, for years, following the old way of diagnosing by the manifest error and correcting it as it stood, was termed "premature prebyopia."

It has been the custom to give such young people rest glasses for near

work. However, these glasses are not needed. The treatment is the education of the function of convergence, the creation of correct habits of innervation and synergetic associations of convergence and accommodation.

Another annoyance usually found with convergence insufficiency is the habit of intermittent monocular and binocular vision. Vision in one eye or the other will fade out, one eye or the other suspends, sometimes for only a fleeting second, sometimes for several minutes. The individual is unconscious of this, only realizing that something seems to be the matter. The slight discomfort experienced is occasioned by the effort at convergence needed when the suspending eye resumes functioning.

This again, is a vestigial trace of the visual habits of the lower vertebrates, who use the eyes in monocular alteration.

This intermittency was first analyzed by McFadden, a Massachusetts optometrist and named by him "Suspenopsia." This in 1922. Previous to this ophthalmology had not recognized the true source of this trouble.

Treatment methods for suspenopsia must appeal to the habit of mental attention. To develop this, we have utilized the stereoscope with partially dissimilar pictures which must both be seen to make the whole. And to create the fixed habit of attention and the habitual response of the version and convergence centers, we have applied the Hazen sliding prisms to the stereoscope. This method is quite effective and we can eradicate the habit of intermittency in some few weeks of daily treatments.

Those with convergence insufficiency and with the habit of suspenopsia are unsafe motor drivers. How many accidents are due to defective binocular co-ordination, it would be impossible to state, since in none of the visual tests recommended by ophthalmologists have these binocular tests been included.

It is enlightening to think of the eyes as the ends of the second cranial nerves which are only one pair of twelve controlling our entire body. And of these twelve pairs of cranial nerves, the better part, seven pairs, are devoted to vision. The second or optic, the third or oculomotor, the fourth or trochlearis, the sixth or abducent, parts of the ophthalmic and superior maxillary branches of the fifth or trigeminal, that part of the seventh or facial controlling the orbicularis palpebrarum and a well suppositious connection in the proprioceptive branch of the eleventh or ported suppositious connection in the proprioceptive branch of the eleventh or spinal accessory.

In considering the other functions of the body including touch, taste, hearing, smell and the great and intricate circulatory system, the pulmonary apparatus, the heart, the digestive and motor activities are controlled by the remaining parts of the twelve pairs, then vision becomes very important and gives one permission to say that the correct functioning of the eyes is of vital importance to good health.

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FELLOWSHIP OF THE AMERICAN ACADEMY OF OPTOMETRY ESTABLISHED AT COLUMBIA UNIVERSITY

In December, 1927, the American Academy of Optometry held its Annual meeting in New York. Columbia University extended its auditorium facilities, and of the faculty, Professors Woll, Southall and Raup delivered valuable addresses.

At the annual banquet Dean George Pegram spoke very helpfully to us in full sympathy with the aspirations of the Academy. He evidently was so favorably impressed with the earnest desire and intent of Academy members to dedicate Academy activities solely to the advancement of optometric science that he turned to me during a recess and said, in effect: "Why does not the Academy consider the establishment of a Research Fellowship at Columbia?"

I wish optometrists everywhere would appreciate the full significance of this invitation, for such it really was. Columbia University is a vast institution, controlling immense resources and possessing an enormous amount of equipment and facilities for research work. There is nothing small about it. It obviously would have nothing to gain by establishing this Fellowship except such reflected glory as might be cast upon it by the accomplishments of one working within the walls of its laboratories.

Of the money to be expended upon the Fellowship not one cent would go to Columbia University. It would all serve to pay the salary of the holder of the Fellowship and for such equipment and experiments as he might need to solve his problems. The total cost would be not more than

$2,000.00 a year.

On the other hand, all of the resources of the University would be placed at the disposal of the Fellow. Immense laboratory facilities, statistics, associate scientists and technicians in all departments, material to experiment with and so on would all be available to him. It would take millions of dollars and years of labor to get what our representative would get for *nothing* and immediately.

It was a signal honor which Dean Pegram conferred upon the Academy in particular and Optometry in general. Considering the great prestige and dignity of Columbia it was no small matter for its official representative, high in its councils, to extend the welcoming hand of co-operation to a group which was struggling along without great resources in either time or money. It demonstrated a keen appreciation of the unselfish and sincere effort of the Academy to accomplish something real and lasting in the world of science and a desire to contribute equally unselfishly and sincerely—an attitude that has always been typical of Columbia toward Optometry.

Naturally, the Academy desired to take advantage of the wonderful opportunity offered and a committee was immediately appointed to study the several phases of the proposition. There were three main factors to be considered:

1. Cost.
2. Subject.
3. Worker.

At first it was believed that the cost would run to about $3,500.00 a year—$2,500.00 for the Fellow and $1,000.00 for equipment. Subsequently it was found that this could be reduced to $2,000.00, to be raised mostly, if not altogether, among Academy members.

The subject was a little more difficult to decide upon, partly because of differing opinions but mostly on account of practicability and emergency. It would not be wise to select something the value of the returns from which would be questionable, nor a subject which was too ambitious or would take too long for solution.

Eventually we selected "Problems in Ocular Myology," it being considered that this was broad enough to permit some individual preference on the part of the worker selected, and yet confined enough to lead to practical results.

It covers a wide range of subsidiary problems from which our representative has selected "Strabismus." That is one which has never been adequately solved, and if something definite and concrete comes from this study of it, everlasting credit will rebound to Optometry. The results will naturally be made available to everyone.

Our hardest task was to select one upon whom the Fellowship could appropriately and wisely be conferred. Few men are competent, experienced and at the same time willing and able financially to devote most of their time to research for the small amount of monetary compensation

there is in it. The truly scientifically disposed mind is not common.

After much conferring, the man selected was Dr. Wm. Feinbloom of Brooklyn. Dr. Feinbloom is a graduate of Columbia and is personally acquainted with many of those with whom he will work. He has had several years of practise and is keenly interested in the scientific side of Optometry. He has displayed marked ability in research work and brings to his new task a most refreshing enthusiasm. It may take him, as well as anyone else, a long time to produce the desired results but we can be sure that for loyal, conscientious devotion to his "job" we could make no better selection. He is an Academy member, a fact which had no particular bearing upon his selection, but one which must be gratifying to Academy members.

No move has been made in this project without a great deal of deliberation. We believe that this is one of Optometry's greatest opportunities to demonstrate its genuine desire to promote scientific research and we wanted to make no mistakes. The membership of the Committee should serve as a guarantee to all Optometrists that this proposition will be handled with care and for the best interests of all concerned. These members are as follows: Drs. Ryer, Koch, Doane, Drakeford and Wiseman, Chairman.

Columbia University has formally accepted Dr. Feinbloom as "American Academy Research Fellow" and he will begin this work at once. As before stated, this will be financed by contribution from Academy members. At present we ask no other contributions but since the work is of importance to all optometrists and may be greatly elaborated if further funds are available, there may be some who wish to contribute toward it. Such gifts should be sent to Dr. J. Fred Andreae, Lexington Building, Baltimore, Md. In accordance with common experience in research work, it may take years of work for Dr. Feinbloom to discover solutions to some of our problems, so no one need fear that we will have too much money.

We do ask, however, that all optometrists lend their moral support. We want them to appreciate that Columbia is doing a big thing for optometry and that a group of their fellow workers has succeeded in convincing as never before one of the greatest educational institutions in the world that scientific optometry is here to stay and that it is something worth encouraging and contributing to. Generous, whole-hearted approval of this altruistic effort will greatly encourage those responsible for it.

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ANNOTATIONS AND SOCIETY PROCEEDINGS

The American Journal of Optometry is the Official Organ of the American Academy of Optometry, as well as the Organ of the Arkansas, Delaware, Indiana, Iowa, Maine, Maryland, Michigan, Minnesota, Nebraska, North Dakota, Oklahoma, Pennsylvania, South Dakota, Vermont and West Virginia Optometric Associations.

The following gentlemen have consented to supply items of interest from their respective sections, acting in the capacity of

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ARKANSAS OPTOMETRIC ASSOCIATION

It is with quite a bit of pleasure, writes Dr. J. J. Livingston of Little Rock, that I give you a report of the twenty-fourth annual convention of the Arkansas Optometric Association. It was the most profitable meeting we have held and I would like to emphasize the intensive interest shown at this meeting. Every man registered, attended almost every session during the three days, all staying until the last word was spoken.

The Association held three short business sessions, presided over by the new president, Dr. C. H. Brown, of Harrison. Dr. O. H. Johnston, Vice-President, of Jonesboro, rendered valuable assistance to the president. Dr. W. H. Dowdell of Malvern, our Secretary-Treasurer, made a very satisfactory report of the past year's activities of the Association showing a substantial balance in the treasury.

The constitution was read and certain needed changes were made in the by-laws, the annual association dues being raised from $7.00 to $10.00 per annum. The Association also went on record as indorsing the suggested raise of the affiliated dues to the National Association from $4.00 to $5.00. The raise was made in the form of a resolution, offered at the National Association at Boston, last June. I will say for the benefit of the men in Arkansas, says Dr. Livingston, that the raise to $10.00 for State and National dues, does not go into effect until January 1st, 1931, so if you are not now a member, you should make application to join before January 1st, and again to those who were not present, allow me to say, our State Association has a contract with Dr. Skeffington for his regular four-year study work in "The Graduate Clinic Foundation." To participate in this Graduate Clinic Work, one must be a member of the

State Association, in good standing. Study Clubs are being formed throughout the State and these groups will receive regular layouts for each month's work. These are supplied by the Graduate Clinic Foundation. If you are not familiar with this clinical training, full particulars will be given on request by the writer of this article, who is State Chairman of the Graduate Clinic Movement in Arkansas.

Our State Association, also, indorsed the Six Million Dollar education campaign, launched at the National Association Meeting at Boston, last June, and in this movement, as well as in the Graduate Clinic Movement, to be eligible you must be a member of the Arkansas Optometric Association.

With these two major developments launched for the upbuilding of Optometry, one educational and the other financial, says Dr. Livingston, one cannot afford to remain out of the State Association. I firmly believe, he continues, that Optometry is coming into its own and that we will see greater progress, in the next four years, than any eight previous years.

The Clinic committee, composed of Doctors J. J. Livingston, F. I. Tibbetts, and C. J. Melton, worked hard to arouse sufficient interest to secure enough money to finance the first clinic, but we will have easy sailing, for the other three, to complete the course, judging from the enthusiastic way in which the thirty men present, responded to the first one.

Skeffington, the chief speaker at the meeting, presented his lectures in his inimitable, masterful manner. It has been five years since we had heard him deliver a lecture and even though he was a forceful speaker then, he is much more effective now. We hope that he may live to see the day when every Optometrist in the United States and Canada will have sat in on his entire four years of Graduate Clinical Work, and that Optometry has risen to the heights in the professional world, that its service to humanity justly demands.

As a close to this report let me repeat that you men who do not now belong to the State Association, put in your application, with the secretary at once, or direct to me. Write for full particulars, how to reap the benefit which naturally comes from the Skeffington-Graduate Clinic Movement and the National Educational Campaign.

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OKLAHOMA ASSOCIATION OPTOMETRIC

During the past month four Graduate Clinics were held in the State of Oklahoma under the auspices of the Oklahoma Association of Optometrists. Dr. A. M. Skeffington of the Graduate Clinic Foundation conducted each of the clinics which were held in Tulsa, Enid, Oklahoma City and Ada. These Clinics, according to Dr. Alexander, were well attended, men coming from various parts of the State to attend the sessions.

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PENNSYLVANIA OPTOMETRISTS ORGANIZE

According to Dr. M. L. Blum of Hazelton, Pennsylvania, optometrists of the Anthracite coal region of Pennsylvania have organized into a special body to meet together at frequent intervals to discuss matters of local regional interest. This organization

will take its place as one of the Pennsylvania Optometric Locals. The first meeting was held October 5th in the Penn-Lee Hotel at Shamokin, the following officers being elected: Dr. H. E. Harris, Shamokin, President; Dr. A. T. Liachowitz, Mahanoy City, Vice-President; Dr. M. L. Blum, Hazelton, Secretary-Treasurer. Executive Committee: Dr. I. G. Pursel, Danville; Dr. Joseph Gelb, Tamaqua; Dr. M. M. Segal, Shenandoah; Dr. C. A. Metcalfe, Sunbury, and Dr. J. McDonald, Lansford.

Dr. Albert M. McConnell, of Pittsburgh, President of the Pennsylvania Optometric Association, was the chief speaker at this first meeting. The next meeting of this Association will be held on November 2nd at Mont Carmel.

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MASSACHUSETTS STATE BOARD

The Massachusetts Board of Registration in Optometry will hold its next examination on November 18, 19, 20 and 21, 1930, at the State House, Boston, Massachusetts. The Practical Examination will include a demonstration of ability to map the central, para-central and peripheral fields. The instruments to be used will include the Ferre-Rand or A. O. Company Perimeter and Stereo Campimeter.

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BACK ISSUE WANTED

Dr. J. J. Brady of Sheldon, Iowa, would appreciate very much having a copy of the No. 1, Vol. 5, January, 1928, issue of the American Journal of Optometry to complete the bound files he has of this publication. Optometrists having a spare copy of this issue should get in touch with Dr. Brady who would appreciate having this copy.

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UNIVERSITY OF CALIFORNIA GIVES COURSE IN PHYSIO-THERAPY

An announcement sent out by A. R. Reinke, Opt. D. Secretary of the California Research Group in the Science of Vision, informs the members that the Board of Directors of that organization endorsed the course in Physio-Therapy given by the University of California, under the direction of F. A. Neal, M. A. The members of the Research Group were urged to enroll in this course.

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SASKATCHEWAN SUMMER COURSE

During the past summer the University of Saskatchewan has offered a short course in Anatomy and Histology to graduate optometrists. According to Dr. Harry S. Hay 30% of the total registration of optometrists of the Province attended this course. The arrangement of the Course was sponsored by Dr. R. T. McGibbon, who is head of the Anatomy Department of the University. At the close of this year's short course Dr. McGibbon outlined a series of lectures for a similar short summer course for Optometrists next year. The outline follows:

Department of Anatomy—General Histology; about five lectures, on

the following subjects: The Animal Cell, Cell Growth and Division, The Germ Layers, The Tissues, Especially Blood, Connective Tissue Muscle and Nerves. Gross Anatomy, about two lectures, on the following subjects: Relation of Orbits to the Mouth, Pharynx, Nose and Ear. Neurology, about five lectures, as follows: Nervous system in general, The Brain, especially in relation to eye, The Cerebral Nerves, and the Sympathetic nervous system.

In the Department of Physiology the following subjects will be discussed: Physiology of Nerve and Muscle, Physiology of Eye—Movements, Dioptrics and Vision. Also Pathology—Phenomena of Inflammation, Degeneration and Repair.

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PENNSYLVANIA STATE COLLEGE

With the opening of the Pennsylvania State College of Optometrists in Philadelphia, for its eleventh session, it was found necessary to acquire temporary quarters to accommodate the large increase in enrollment, according to Dean Albert Fitch. Sixty-five freshmen were accepted of the total of 110 applicants who were eligible to enter. This represents fifteen more students than were accepted in the last freshman class which was made possible only through the aquisition of the temporary quarters referred to. The temporary quarters comprise the former Osteopathic College and Hospital building, which will provide larger laboratory space for anatomy, chemistry, bacteriology, histology and pathology. This again shows the crying need for educational facilities for this educational center. Optometrists throughout America should unit in supporting the drive now being sponsored by this institution for funds for greatly needed new building facilities.

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LECTURES AND CLINICS BY DR. KURTZ

Dr. J. I. Kurtz, optometrist of Minneapolis, will give a course of lectures and clinical demonstrations in the application of Ocular Physical Therapy during the month of December. Classes will be held at Columbus, Cleveland, Chicago, Des Moines, Gary, Ind., Indianapolis, Milwaukee, Minneapolis and Omaha. Dr. Kurtz will cover in his lectures these subjects: Ocular Physical Therapy a natural part of the practice of Optometry; The effects of Physical agents upon the muscles and nerves; The technique for the control and treatment of cataract; The application of light, applied psychology (or psycho-therapy) in optometry and the general management of difficult eye cases.

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